

WHAT IS CLAIMED IS:

1. A process for the synthesis of a diamond surface on a monolithic piece, said piece being predominantly metal carbide, by etching away at least a portion of the metal from the metal carbide, leaving essentially only carbon on at least the surface of the monolithic piece of metal carbide comprising:

reacting a surface of said monolithic piece of metal carbide with a hydrogen- and halogen-containing gaseous etchant, having a hydrogen gas concentration of at least 0 to two moles of hydrogen for every two moles of halogen, and having a halogen gas concentration sufficient to remove a portion of the metal from the metal carbide surface, at a temperature, pressure and for a time sufficient to provide essentially only diamond or diamond and carbon on the surface of said metal carbide.

2. The process of claim 1, wherein the reaction pressure is about 1 atmosphere.

3. The process of claim 1, wherein the reaction temperature is in the range of at least about 100° C.

4. The process of claim 3, wherein the reaction temperature is at least about 500° C.

5. The process of claim 4, wherein the reaction temperature is in the range of about 500° C to about 1,100° C.

6. The process of claim 5, wherein the reaction temperature is in the range of about 800° C to about 1,000° C and the reaction time is in the range of about 10 minutes to about 62 hours.

7. The process of claim 6, wherein the reaction time is in the range of about 0.5 hour to about 8 hours.

8. The process of claim 1, wherein the metal carbide is silicon carbide.

9. The process of claim 1, wherein the reaction pressure is in the range of about 0 atmosphere to about two atmospheres.

10. The process of claim 1, wherein the reaction pressure is in the range of about 0 atmosphere to about one atmosphere.

11. A process for controlling the degree and type of carbon surface formed on a metal carbide comprising:

contacting a surface of a metal carbide with an etchant gas comprising a mixture of a hydrogen gas and halogen-containing gas in a molar ratio of hydrogen gas to halogen-containing gas in the range of 0:2 to 1:2; and

adjusting the concentration of halogen-containing gas, hydrogen gas, temperature and time of reaction to provide a diamond surface on said metal carbide, and mixtures of diamond and graphitic carbon thereof.

12. The process of claim 11 including contacting the metal with a first gaseous etchant having a first concentration of halogen-containing gas and first concentration of  $H_2$ , and thereafter contacting the metal carbide with a second gaseous etchant having a different concentration of both halogen-containing gas and  $H_2$ .

13. The process of claim 11, wherein the halogen-containing gas is selected from the group consisting of fluorine, chlorine, bromine, iodine, hydrogen chloride, and mixtures thereof.

14. The process of claim 13, wherein the halogen-containing gas is chlorine in a concentration of about 0.1% to about 10% by volume of the gaseous etchant.

15. An improved method of manufacturing a bearing from a mass of powdered metal carbide particles treated to include a surface layer comprising diamond for more uniform, homogeneous distribution of diamond throughout at least a portion of said metal carbide, comprising

reacting a surface of a plurality of powdered metal carbide particles with a halogen-containing and hydrogen-containing gaseous etchant, having a hydrogen gas concentration of at least 0.3 mole of hydrogen for every two moles of halogen, and having a halogen gas concentration sufficient to remove metal from the metal carbide surface, at a temperature, pressure and for a time sufficient to provide a defined percentage of diamond on the surface of said metal carbide; and

disposing said treated, powdered metal carbide particles, having a diamond surface, in a mold in a desired shape of said bearing, and heating said powdered particles at a temperature and for a time sufficient to form a coherent mass of said powdered particles in the shape of said mold, said bearing having a diamond-containing bearing surface.

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16. A bearing disposed as part of a mechanical device, said mechanical device including a solid part in frictional contact with said bearing such that there is relative movement between said solid part and said bearing when the mechanical device is being operated, wherein the bearing includes a bearing surface in relative movement with respect to said solid part, said bearing surface having enhanced wear and friction properties by contacting a metal carbide, at a portion of said metal carbide that forms said bearing surface, with a halogen-containing and hydrogen-containing gaseous etchant, having a hydrogen gas concentration of at least 0.001 mole of hydrogen for every two moles of halogen, and having a halogen gas concentration sufficient to remove metal from the metal carbide surface, at a temperature, pressure and for a time sufficient to provide essentially only diamond or diamond and carbon on the bearing surface of said metal carbide.

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17. The bearing of claim 16, wherein the bearing surface is a ball bearing surface in the shape of a sphere.

18. The bearing of claim 16, wherein the bearing surface is pointed, forming an end of a needle bearing.

19. The bearing of claim 16, wherein the bearing surface is cylindrical, forming a roller bearing.

20. The bearing of claim 16, wherein the bearing surface forms the bearing surface of a thrust bearing.

5 21. The bearing of claim 16, wherein the bearing surface is annular and surrounds a rotating shaft to seal a volume between said rotating shaft and said bearing surface to prevent fluid from flowing between said bearing surface and said rotating shaft when said shaft rotates.

10 22. The bearing of claim 21, wherein the seal is disposed in contact with a shaft of a water pump.

23. The bearing of claim 21, wherein the seal is disposed in contact with the shaft of an oil pump.

24. A method of manufacturing a prosthesis comprising:  
15 shaping two monolithic metal carbide pieces such that said pieces are shaped complementary to each other, one shaped piece including an articulating end surface and the other shaped piece including a complementary shaped anchor end surface for contact with said articulating end surface, said articulating end surface moveable with respect to said anchor end surface; and  
20 contacting at least one of said shaped pieces with a halogen-containing and hydrogen-containing gaseous etchant, having a hydrogen gas concentration of at least 0.3 mole of hydrogen for every two

moles of halogen, and having a halogen gas concentration sufficient to remove metal from the metal carbide piece, at a temperature, pressure, and for a time sufficient to provide essentially only diamond, or diamond and carbon on a surface selected from the group consisting of the articulating end surface, the anchor end surface, and both the articulating end surface and the anchor surface.

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25. A microstructure comprising a structural member having a surface formed by contacting a metal carbide portion of said structural member, at a surface of said metal carbide portion, with a halogen-containing and hydrogen-containing gaseous etchant, having a hydrogen gas concentration of at least 0.3 mole of hydrogen for every two moles of halogen, and having a halogen gas concentration sufficient to remove metal from the metal carbide surface, at a temperature, pressure and for a time sufficient to provide essentially only diamond or only diamond and carbon on the surface of said metal carbide portion.

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26. The microstructure of claim 25, wherein the silicon microstructure includes an electromechanical apparatus.

27. The microstructure of claim 26, wherein the structural member is a moving member of the electromechanical apparatus.

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28. The microstructure of claim 26, wherein the structural member includes an electrical contact.

29. A microelectromechanical device comprising a structural member having a surface formed by contacting a metal carbide portion of said structural member, at a surface of said metal carbide portion, with a halogen-containing and hydrogen-containing gaseous etchant, having a hydrogen gas concentration of 0 to two moles of hydrogen for every two moles of halogen, and having a halogen gas concentration sufficient to remove metal from the metal carbide surface, at a temperature, pressure and for a time sufficient to provide essentially only diamond or only diamond and carbon on the surface of said metal carbide portion.

10 30. The microelectromechanical device of claim 29, wherein the microelectromechanical device includes an accelerometer.

31. The microelectromechanical device of claim 29, wherein the microelectromechanical device includes an electrical switch.

15 32. The microelectromechanical device of claim 29, wherein the microelectromechanical device includes a valve for controlling the flow of a fluid.

33. The microelectromechanical device of claim 29, wherein the microelectromechanical device includes a fluid pump.

20 34. The microelectromechanical device of claim 29, wherein the microelectromechanical device includes an electric motor.

35. A catalyst comprising a catalyst support containing a metal catalyst said catalyst support comprising diamond formed by contacting a metal carbide, at a portion of said metal carbide that forms said catalyst support surface with a halogen-containing and hydrogen-containing gaseous etchant, having a hydrogen gas concentration of at least 0.3 moles of hydrogen for every two moles of halogen, and having a halogen gas concentration sufficient to remove metal from the metal carbide surface, at a temperature, pressure and for a time sufficient to provide essentially only diamond or only diamond and carbon on the catalyst support surface of said metal carbide.

10 36. A molecular sieve for separation of molecules comprising carbon formed by contacting a metal carbide, at a portion of said metal carbide that forms said molecular sieve surface with a halogen-containing and hydrogen-containing gaseous etchant, having a hydrogen gas concentration of at least 0.3 mole of hydrogen for every two moles of halogen, and having a  
15 halogen gas concentration sufficient to remove metal from the metal carbide surface, at a temperature, pressure and for a time sufficient to provide essentially only diamond or essentially only diamond and carbon on the molecular sieve surface of said metal carbide.

37. A process for the synthesis of an ion-exchange material from a monolithic piece of predominantly metal carbide, by etching away at least a portion of the metal from the metal carbide, leaving essentially only carbon on at least the surface of the monolithic piece of metal carbide comprising:

25 reacting a surface of said monolithic piece of metal carbide with a halogen-containing and hydrogen-containing gaseous etchant, having a hydrogen gas concentration of at least 0.3 mole of



hydrogen for every two moles of halogen, and having a halogen gas concentration sufficient to remove a portion of the metal from the metal carbide surface, at a temperature, pressure and for a time sufficient to provide essentially only diamond or only diamond and carbon on the surface of said metal carbide; and

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seeding said formed carbon surface with exchangeable ions.

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